THE HARBOR

OF

NEW-YORK.

EXTRACTS FROM THE "SCIENTIFIC AMERICAN," JULY 10, 1886.
" " " "NEW-YORK TIMES," AUGUST 11, 1886.
" " " "NEW-YORK STAR," FEBRUARY 10, 1886.

NEW-YORK:
PRESS OF THE CHAMBER OF COMMERCE.
1887.

CHAMBER OF COMMERCE OF THE STATE OF NEW-YORK.

NEW-YORK, *January 15th*, 1887.

DEAR SIR:

The permanent improvement of New-York Harbor is a matter of National importance. In addition to measures of a stringent nature required to prevent the acts of vandalism known to have been constantly committed in the past, and which it is hoped and expected will be provided by Act of Congress at this session, there exists a pressing demand for a Channel, affording a depth of say thirty feet at mean low tide, to accommodate the present and future requirements of Commerce. The need is recognized by, and the sum of $750,000 was appropriated at the last session of, Congress, to be spent by the Secretary of War upon that plan which he might decide to be the one best adapted to the needs of the Port.

The only plan at the moment before the Secretary, so far as is known, is one devised by the Engineers of the United States, a clear summary and synopsis whereof will be found in the accompanying pamphlet.

My object is to invite your valued professional consideration of that plan, and to ask you, in behalf of our great ocean gateway, to give me your candid opinion on the advisability of its adoption. I confess, in advance, to entertaining, from my point of view, a positive conviction that it cannot be thought of, and my principal reasons are stated in that pamphlet; but being very desirous that I may not fail to take into account every consideration possible, I rely, first, on the views of that class most competent to the scientific side of the problem, viz., the Civil Engineers, and hence this request.

Your early reply will be deeply appreciated and valued by

Yours respectfully,

Chairman Committee on the Harbor and Shipping.

Charles R. Lowndes Jr.

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[*From the Scientific American of July* 10, 1886.]

NEW-YORK HARBOR.

THE Chamber of Commerce some months ago was petitioned by a large number of merchants and agents of shipping to take some action looking to the erection of an enlarged and, if possible, more convenient channel into this port. Its Committee on this subject called a public meeting, and formed a large General Committee on Harbor Improvements and Protection, embracing a number of the most influential men connected with public affairs and commerce. This meeting also resulted in an earnest petition to Congress, asking that the Secretary of War be authorized to advertise for and "contract with responsible parties for the speedy deepening and widening of a channel to afford 30 feet depth of water and not less than 500 feet in width at mean low tide, which would afford 35 feet and a width of 1,500 feet at high tide, in and through that part of the bay at Sandy Hook which experience and judgment indicate as best calculated to be permanently maintained by nature alone, after the first guiding and aiding works have been constructed, and which shall be effectually lighted at night throughout its entire length." It was intended that nothing be paid until the object be partly attained—the profits and a large proportion of the expense to be entirely dependent upon the self-sustaining character of the work. The necessity for such relief has been most apparent and pressing for a long time, and it only needs to glance at the change which has taken place in the requirements of vessels (Fig. 1) to be strongly

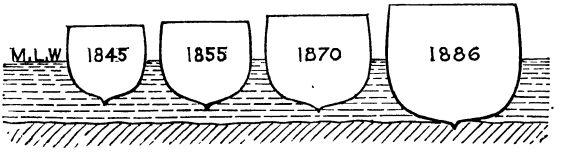
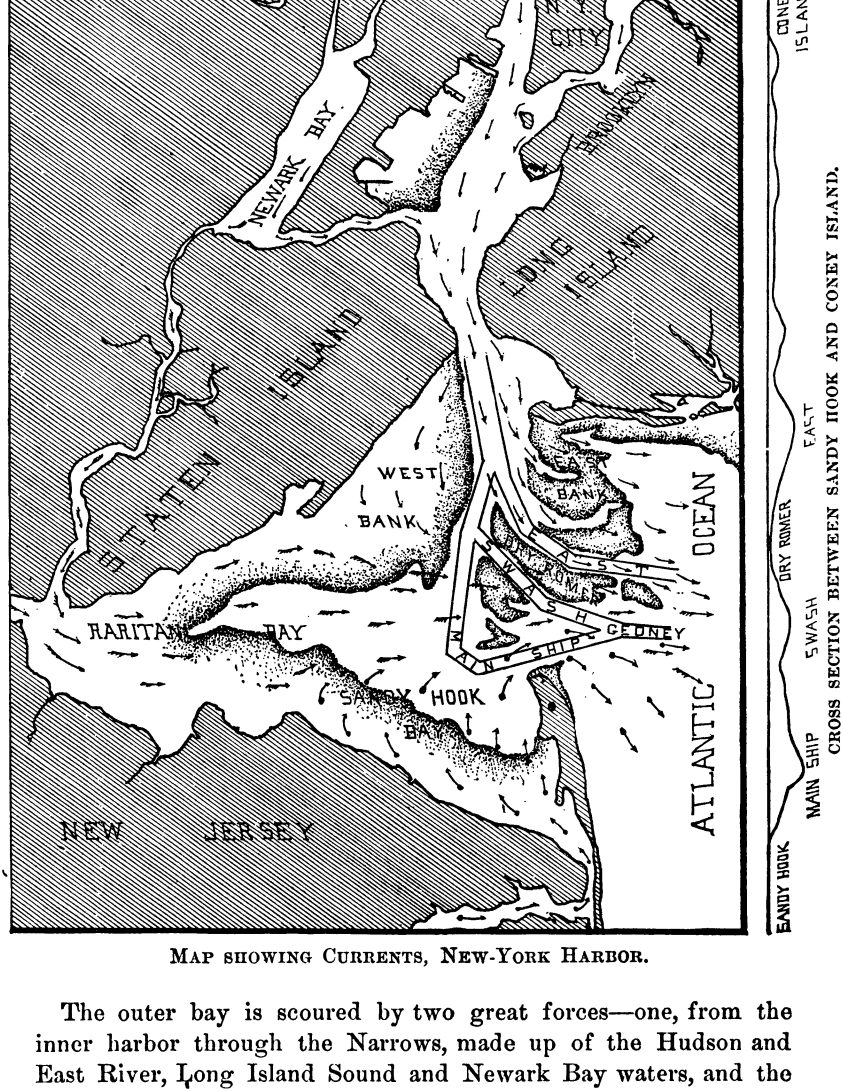


FIG. 1.—SECTIONS SHOWING GROWTH OF OCEAN STEAMERS.

impressed with this fact. The memorial was forwarded to Congress and presented in the House, but as yet no specific action has been taken. The Chairman, Mr. A. Foster Higgins, of the Standing Committee on Harbor and Shipping, caused to be initiated on behalf of the Chamber of Commerce of New-York a simple, plain and business-like way of grappling with the subject. Two years ago, work was commenced by having a series of historical maps and models made. These clearly indicate the areas on which extensive improvements might be undertaken. The numerous maps, extending back 150 years, embrace the entire harbor from Long Branch on the south to Yonkers on the north, the east side of Jamaica Bay on the east and Raritan River, just west of Perth Amboy, on the west. There are also sectional maps, giving all the changes that have taken place in the outer bay between Sandy Hook and Coney Island from 1735 to 1884. The alterations in Coney Island and Sandy Hook are especially interesting as clearly showing how important their protection and retention are to the maintenance of the present and improved depths in the outer bay. Although these maps cover the larger part of the subject, it is still necessary to make continuous and simultaneous tidal and current observations in order to secure the factors with which to calculate the velocity, direction, volume and exact effect of each separate body of water upon each channel or upon any harbor works that might be erected.

This important map work was followed by the carving in wood of several models. The accompanying illustration is a photographic reproduction of the general small scale model, $3\frac{3}{4}$ inches to the mile, which represents an area of 800 square miles inclosed within the limits above mentioned. The heights and depths of the hills and valleys, and the channels and shoals in the upper and lower bays of New-York Harbor, are accurately carved from solid wood. The wooded and marshy regions, and the buildings of the cities and villages, are all indicated in relief and appropriately painted. When water is let into the depressions which represent the ocean, bays, and tributary rivers, we obtain an effect as perfect as though the region were viewed from a balloon.

To thoroughly understand the character of the bottom of the outer bay, it is necessary to study carefully the force and directions of the currents passing between Sandy Hook and Coney Island, which are distant from each other 7 miles. The accompanying outline map, or key to the large view, will serve to make the following description plain.



MAP SHOWING CURRENTS, NEW-YORK HARBOR.

The outer bay is scoured by two great forces—one, from the inner harbor through the Narrows, made up of the Hudson and East River, Long Island Sound and Newark Bay waters, and the other, from the outer harbor, a compound of Raritan Bay, Raritan River, and Arthur Kill waters with those from Sandy Hook Bay and the Shrewsbury and Navesink basins. Both of these forces pass seaward between Sandy Hook and Coney Island, being divided by the Dry Romer Shoals, and it is estimated that the quantities of flood tide waters are almost identical on either side of the shoal,

while the ebb tide waters are from ten to fifteen per cent. stronger over the east bank and through the channels north than through the channels on the south side of this shoal. It is probable that none of the waters that pass through the Narrows on the ebb tide ever flow south of this shoal, except at the seaward end of the bar, and under special conditions, such as high freshets or the backing up of the waters by unusual winds. The water flowing through the Narrows, although coming from three distinct sources, may be regarded as a single stream running in a southerly direction so far as the effect on the channels of the outer bay is concerned. The outer harbor waters, on the other hand, are divided into two independent forces, which only unite on the same course as they elbow their way through the opening between Sandy Hook and Coney Island, the Sandy Hook force running northerly directly opposite to the inner harbor waters, and the Raritan Bay force easterly and at right angles to both, these latter waters squeezing their way between the others, and forcing them to assume, like itself, an easterly direction, and keep their own side of the way. The constancy of these forces is shown by the fact, that the sand bar fronting the entrance has maintained its position and depth with very slight variation during the past fifty years. This bar is the result of the flood tide from the ocean and storm wave power on the one hand, as opposed to the ebb tide and freshet power on the other.

The extensive inner bar, west and alongside of FLYNN's Knoll, has, during the past 150 years, with two doubtful exceptions, only varied 3 feet in depth. The Dry Romer has been nearly equally constant. The outer bar, or GEDNEY's Channel, has not varied 4 feet during the above period.

There are really five entrances to the harbor, beginning at Sandy Hook, and in a line north therefrom : (1) the Main Ship Channel ; (2) the Swash Channel ; (3) East Channel ; (4) Fourteen Feet Channel ; (5) the Coney Island Channel. These are all used by small vessels plying coastwise, numbering about 16,000 ; and the two great ones, known as (Nos. 1 and 2) the Main Ship and Swash channels, are exclusively used by vessels of large draft of water, GEDNEY's Channel giving them common access to the ocean across the outer bar. The former, although much longer and requiring five different courses to navigate it, is principally used, owing to its deeper water. A third channel, called the East, requiring only two different courses, was only known in an official and published form in 1835, when the work of the United States Coast Survey was begun. During the past fifty years this channel has proved

the most constant of the three ; the deep water area had, as shown by a careful comparison of official surveys, improved twelve per cent. in 1857, fifteen per cent. in 1872, and thirty per cent. in 1884, over its state in 1835. The depth over the bar fronting it, the only obstruction to a free and unimpeded channel to the ocean, has deepened about 2½ feet.

In response to the general demand for more water, there are today several proposals for effecting the required relief. Probably the oldest plan is to build an artificial bar well out in the ocean to prevent the storm sand from being driven on the natural bar ; another is to dredge a channelway through the outer and inner bars of the Ship Channel, and protect the places so dredged by submerged jetties ; a third is to run stone dikes northeast from Sandy Hook and thus contract the entrance ; a fourth is to let the existing channels alone and to dredge out and maintain by jetties the East Channel, thereby obtaining nearly a direct line into New-York ; a fifth, and last, the construction of a stone dike running south-southeast from Coney Island, for a distance of about four miles across the entrance, to greatly confine the waters, and force them to scour the channel out. These plans cannot be all right, or even reasonable ; some would probably ruin the port. It would, therefore, seem prudent, considering the enormous interests involved, to ascertain without delay the exact movements and relations of the forces to each other as affecting the several channels. The problem to be solved, is how to improve one of the existing channels with the least possible disturbance of the present regimen of the harbor. The run of the tides must be coaxed by science, and not opposed by brute force.

Any work that would augment the commerce of New-York, by providing a shorter, deeper, and in every respect a better entrance to the harbor, would be of national importance, and should, therefore, be undertaken by the general Government, under whose control it very properly belongs, and not by the States of New-York and New-Jersey.

The rapid increase in the draught of large ocean steamers and the sharp competition in speed of the several lines make necessary the deepening and straightening of the channel if we still desire these vessels to anchor at our docks. Even now the largest vessels can only come in during certain stages of the tide, and the least deviation from their course insures grounding.

If we do not desire their presence, an active indifference will in a very short time compel them to seek other harbors. The builders of steamships have attained speed and size to satisfy public de-

mand, and they will not be likely to sacrifice these features by so changing their models that they may easily enter New-York Harbor.

THE HARBOR OF NEW-YORK.

Communication of the Chairman of Committee "on Harbor and Shipping" of the Chamber of Commerce on its Proper Improvement, and Criticism of the plan proposed by U. S. Engineers.

[*From the New-York Times, August* 11, 1886.]

To the Editor of the New-York Times:

SIR:

* * * * * * * *

ANALYSIS OF THE PLAN AS CONTAINED IN THE ENGINEER'S REPORT. LIEUT.-COL. GILLESPIE'S REPORT AND PLAN.

An appropriation of $200,000 for "deepening GEDNEY'S Channel through Sandy Hook Bar," has been made in the River and Harbor Bill of 1884. Lieutenant-Colonel G. L. GILLESPIE was placed in charge of that work, and instructed to submit a project for the deepening to be accomplished. In the pursuance of his duties he submitted a "project for improvement." He states: "The Act of July 5, 1884, makes a specific appropriation for the deepening of GEDNEY'S Channel, and this project is, therefore, limited to that channel."

(1.) He notes that "the entire ocean entrance on the shortest line between Sandy Hook and Coney Island is seven statute miles;" and that "the outward scour is just able to maintain a least depth of 21 to 23½ feet at low stage." He states: "A contraction of this entrance of two miles by a construction springing from Coney Island, and rising to half tide over the wide shoal on that side, would increase the ebb flow over the channels to the southward by training the ebb from the Narrows, and would give the same velocity of currents to the entrance as before, provided the average depth of the cross section was made 27 feet."

(2.) "Average velocity of current, one mile per hour; duration, six hours; present average, 20 feet. This contraction would doubtless require the strengthening of Sandy Hook by a crown of riprap, extending from the western to the eastern shore, supplemented by jetties northward, and anchored in deep water. Such work should be solidly made, to resist the action of the sea, and would cost a sum much beyond the present appropriation. Before considering such a project it would be well to try the experiment of deepening the channel across the bar by dredging, to see whether it would be self-maintaining [citing examples of foreign work proving successful.] If the experiment fails here, then the composition and nature of all shoals should be determined by deep borings, the actions of the currents definitely learned, and the method by contraction studied."

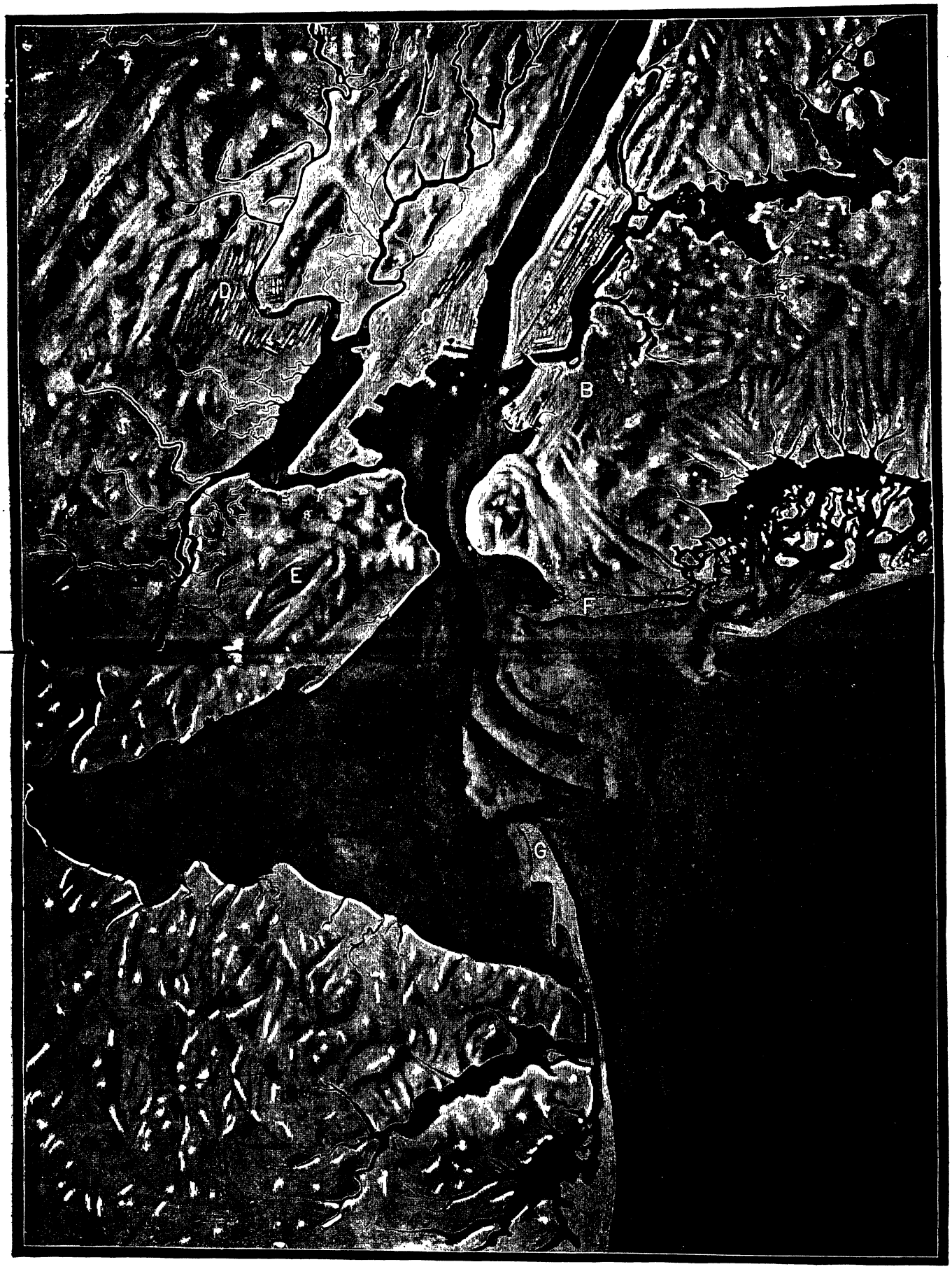
(3.) Lieutenant-Colonel GILLESPIE then leaves this project entirely, and goes on to submit a plan for present consideration, which is briefly, "to open a channel through the single shoal lying across the western entrance to GEDNEY'S Channel between the 30-foot curves." He specified the three modes by which this cut may be effected, viz., "by dredging; by any other method providing for the raising of the obstructing material and carrying it elsewhere to an assigned place of deposit, or by any well-developed plan of removal by artificial currents." He says: "I do not know that the cut once opened will be self-maintaining, but the present appropriation being small, it is well enough to experiment with it, and if the same prove moderately successful, the use of large sums for contraction by stone structures may be avoided, and the annual appropriation for maintenance may be placed at comparatively low figures." He also calls attention to a "shoal in the main channel, west of FLYNN'S Shoal, which, although not so urgent as the former channel, yet should be removed simultaneously with the cut previously recommended." He estimates for this additional cutting a further sum, varying according to the depth contracted for. For both these cuts the aggregate varies from the total sum of $970,000 for 30 feet at mean low water and 1,000 feet wide channel, down to $222,200 for 27 feet deep and 800 feet wide, to which sums from 30 to 50 per cent. is to be added for "irregularities in cutting," if the material is to be paid for as measured in scows.

He concludes by "recommending that the available funds be ap-

plied, so far as they will go, toward opening the Thirty-foot Channel, and that Congress be asked for an additional appropriation of $707,000" to complete the cut not only through GEDNEY'S Channel, but also for the main channel on the inside, or "for application toward the commencement of permanent works of contraction, if such works be found necessary." Lieutenant-Colonel GILLESPIE attaches a most valuable chart, containing all his own soundings and accurate delineations of the shoals and channels. A most admirable report, commending itself by its conservatism and caution to every mind.

AMPLIFICATION OF THE COLONEL'S PLAN, BY THE BOARD OF ENGINEERS, AND ITS CONCLUSIONS.

His report was "referred to the Board of Engineers for Fortifications and for River and Harbor Improvements." These gentlemen describe fully the character of the waters of the harbor and its entrances and channels, they set forth the agencies which tend to diminish the navigable depths through the bar at Sandy Hook, they also analyze more in detail the tidal flow, giving figures estimated as the volume thereof, and likewise of the "land drainage water." *En passant*, they note that "if a dike rising to half tide were built running from Coney Island about south-southeast towards GEDNEY'S Channel, for a length of five miles, the water cross section at Sandy Hook would thereby be reduced from 790,000 square feet to 470,000 square feet, and the mean velocities would be nearly doubled;" but they add, "It is not thought that so great a contraction as that will be necessary to give depths of thirty feet. It is impossible to predict precisely what contraction will be necessary to maintain a depth of thirty feet, but, from the depths at the Narrows, the Board has little doubt that this depth can be maintained notwithstanding the obstructive agencies active on the bar. In building such a dike it should at first certainly not be brought above low water, and, perhaps, not so high. While being lengthened its effects should be carefully watched; any important reduction in the tidal prism inside being avoided by allowing the new channels to fully develop, aiding them by dredging if necessary, and the dikes should be carried no further than may be found by experience to be required." "As the increase of current would cut away the head of Sandy Hook, it would have to be protected. If, after the construction of the dike, the main interior channels should remain as they now are, the dredging through FLYNN'S



A. NEW-YORK CITY. B. BROOKLYN. C. JERSEY CITY. D. NEWARK. E. STATEN ISLAND. F. CONEY ISLAND. G. SANDY HOOK.

BIRD'S EYE VIEW OF NEW-YORK HARBOR, WITH WATER REMOVED.

Shoal, recommended by Col. GILLESPIE, would form part of the plan," but as the latter would be valuable in any event, they " recommend dredging to that extent in advance of the completion of the Thirty Foot Channel on the bar."

The Board gives a brief consideration of another plan, namely, a dike two and a half miles long, running from the southwest side of GEDNEY'S Channel, southwest or west-southwest to Sandy Hook. They object to it for various reasons, and while admitting that it would probably increase the depth of GEDNEY'S Channel, yet " the result might be to open the East Channel, the Fourteen Foot Channel or the Coney Island Channel. As it is important that but one channel should exist over the bar if deep water is to be maintained there, such a result would be unfavorable." They conclude in favor of the Coney Island dike, and say, " should changes in channels or other results in the progress of the work indicate the advisability of any portion of such a dike from Sandy Hook, it might then be constructed."

RECAPITULATION OF BOARD'S CONCLUSIONS AND RECOMMENDATIONS.

The Board recapitulates, it " recommends the construction of a stone dike, running about south-southeast from Coney Island to such distance as shall be found necessary, and probably not less than four miles; the protection of the head of Sandy Hook, and the dredging of a thirty foot channel from deep water near Sandy Hook to deep water below the Narrows; also the immediate dredging of a channel 1,000 feet wide and twenty-eight feet deep through the shoal west of FLYNN'S Knoll as soon as Congress shall grant funds, and that the existing appropriation be applied to dredging GEDNEY'S Channel to twenty-eight feet depth." Here we have the whole matter, and I trust that every one who glances at or is in the least interested in this question will carefully study this verbatim statement of the report and its conclusions.

THE PLAN DEEMED MOST OBJECTIONABLE.

Now, I will not contend with Gen. NEWTON that I am fitted by education or experience to decide that any plan is absolutely well digested, well considered, and free from serious objections. Scientific engineers could easily discover many features not to be observed by me, nor would my common sense or business experience permit me to be so unwise as to trust my judgment on any important mat-

ter upon which I could easily command the opinion of experts; but I do claim to be able to easily discern and recognize when a plan is unwise, not well considered, and contrary to the interests of this harbor, and such I respectfully but decidedly pronounce this project of permanent improvement to be, for the following reasons:

REASONS WHY IT SHOULD NOT BE ADOPTED.

First.—It cannot for a moment be seriously entertained by the merchants of New-York, that a work shall even be begun which has for its declared object the closing of all the channels into this harbor but one, even though that one be increased to thirty feet depth and be self-maintaining. Here is a perfect illustration of the scientific mind working upon one definite idea, and, although perhaps successfully dealing with that problem, losing sight entirely of far weightier considerations. What business man can be found who for a moment will contemplate with complacency closing the magnificent entrance, now seven miles wide, to one of possibly less than three miles? How could we consent that three existing channels, used by thousands of vessels every year, should be forever closed, and all vessels coming from the north and east be obliged to go four miles further south to enter, thus making eight miles additional navigation? Think of the vastly increased risks of collision. Consider the increased volume and velocity of tide, now so hard to be overcome by sailing vessels at certain times. It needs but a moment's consideration to decide that far better let the entire bar and nature alone, and try to prevent the injuries by man than thus effect what is really not a necessity, but a measure of expediency, and, therefore, to be weighed against its effects upon the entire shipping community. While it is desirable to afford accommodation to the grand steamers which ply to New-York, it certainly should not be given at the expense of the welfare of the multitude of our own native vessels.

Second.—Mark the cautious presentation of the matter by Col. GILLESPIE. He declares at the outset that he is confined in his consideration of the subject to one channel, viz., GEDNEY'S. He advances views based upon a dike of two miles in extent, and, foreseeing possible evil results, foretells the protection required by the opposite shore, even with this contraction. He distinctly advised that even such a limited project shall not be considered until the experiment of dredging across the bar be first made to deter-

mine whether it would be self-maintaining. He then advises still further measures before considering the plan, viz., that if the experiment fails, then that more extensive surveys and examinations of the nature of the shoals and the action of the currents be definitely learned, and even the method of contraction studied. How admirable does this conservatism strike a business man, and how readily does confidence go out to him in consequence. The Board, however, deals with the difficulty more heroically ; they clearly are devising a plan to get " thirty feet draught of water and a channel which will be self-maintaining " at any cost, either of time, money or sacrifice of all interests of the small vessels. They advise a dike, not less than four miles, and possibly five, contemplating the further and additional closing of all other existing channels. That there is no possible misrepresentation in this inference it is only necessary to refer to their comments upon the other plan of a dike, from Sandy Hook, northeast or east-northeast to the southwest side of GEDNEY'S Channel. The principal and apparently conclusive reason for rejecting this is stated to be because one of its operations may be to open the three other channels, (*i. e.*, the " East," " Fourteen-Foot," and " Coney Island,") and that it is important that but one channel should exist over the bar, so that deep water can be maintained. It cannot be supposed that the Board as a body had any additional information with which to deliberate beyond that possessed and acquired by Col. GILLESPIE, and the ill effects deemed possible by him were sufficient in his judgment to influence him in advising that the project of which the Board's is an amplification, should not be considered at all until the tentative work had given results, and the whole mass of information necessary to an intelligent statement of the problem had been previously acquired.

CONSERVATISM RECOMMENDED.

This is precisely what has been repeatedly urged by the Chamber of Commerce in various ways, and at its instance a sum of $50,000 was placed at the disposal of the Secretary of War to be spent by him in determining the best plan, out of the $150,000 recommended by the House of Representatives in its first River and Harbor bill. But with the increase of $750,000 the whole matter is placed so freely at the discretion of the Secretary of War that it may be confidently expected he will adopt this very necessary condition precedent at once, and not await the results of any tentative measures, but have fully ascertained and recorded absolute knowledge of the shoals,

the tides, the volume and force of the waters aiding in the outward scour, and their present precise direction and operation, before spending a considerable sum in a direction that may afterwards be found useless.

APPEAL TO PUBLIC EXAMINATION OF PLAN AND OBJECTIONS.

Let the public judge whether I have been mistaken in stating that there is not as yet any well-considered plan fixed on. For one I solemnly protest against this scheme of diking the harbor, to the fatal contraction of its entrances, and the vastly increased risks to all native vessels, whereby a comparatively small class of steamers will get some additional, yet most valuable, facilities. Surely it is wiser to try numberless expedients and measures to improve the existing channels, or some one of them, than to adopt a measure whereby any one of them will be closed, and even to abandon all attempts to get more water than is now afforded, than to shut up all the channels but one. Eminent shipbuilders even now dispute the wisdom of the construction of vessels drawing so much water, and it would be, of the two, the lesser evil to force the remedy in the form of vessels than to ruin our entrance to accommodate those drawing more than 24 feet, loaded.

THE CHAMBER'S ATTITUDE AND DUTY.

I must remind these gentlemen that the Chamber of Commerce was formed to protect the interests of the merchants of the State of New-York and the commercial interests of the country. They have placed me in the honorable position of the Chairman of the Committee whose duty it is to learn and study everything affecting the harbor and shipping of New-York, and, as such, I will not be deterred from using the utmost of my intelligence to perform this duty, whether it prove agreeable to the engineers or not. It is my desire that this should be done in the utmost fairness and courtesy to them, and, if it is not to be attained, it will be their fault alone.

At this moment we are not, happily, threatened with any impending danger. The Secretary of War is invested with the complete power of adopting his own personal conclusions as to the manner in which this $750,000 is to be spent. He will necessarily consider the arguments in favor of and against all plans, and we shall be quite content to await his decision, and which I should have done without this public communication had not the attacks on me

personally forced its production. The arena of discussion of plans should now be transferred to the tribunal to which Congress has committed its present appropriation, and, until his decision is made, I propose to refrain from further communications unless driven thereto. I, however, invoke public expressions from all connected with the shipping interests of the country as to the views herein expressed upon this plan.

(Signed,) A. FOSTER HIGGINS,
Chairman of Committee on Harbor and Shipping of the Chamber of Commerce, New-York.

NEW-YORK, TUESDAY, *August* 10, 1886.

[*Extract from the New-York Star, February* 10, 1886.]

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Although the East Channel has a constancy of situation and depth during the last fifty years—as far back as the most reliable surveys exist—*largely in excess of either of the other channels*, it is, as a matter of fact, of no practical use to the port, chiefly owing to its outer end being blocked by an extensive sand bank, the northern portion of the bar, over which there is an average depth of about twenty-one feet at mean low tide; and for this cause little or no attention has been paid to its further development.

The shoal places in the Swash Channel extend pretty much its entire length, ranging, say from twenty-three and one-half feet to twenty-six feet at the same state of tide, while in the Main Ship Channel the depths vary from about twenty-three and one-half feet to twenty-seven feet at mean low tide. In point of distance, the East Channel is only six miles in length from deep water to deep water; the Swash, eight miles, and the Main Ship eleven miles. Two courses being requisite in the first, four courses in the second, and five courses in the third, the marked reduction in the alteration of the ship's helm and position of range lights during night time are matters of no slight importance to easy and safe navigation.

* * * * * * * *

Looking at the position and trend of these shoals, it becomes a question as to whether any work in the nature of removal is likely to be permanent if undertaken by dredging or any other process. This brings us to a consideration of the forces that form and main-

tain these banks. Roughly speaking, every twenty-four hours the great ocean tide rises and falls, sending two volumes of water in and two volumes at return tide out of the harbor through the Narrows across the outer bay. If this force were alone to be considered, the problem of deepening the channels already in use, namely, the Swash and Main Ship, would be comparatively easy ; but when we see, on reference to the map, that there are two other large reservoir areas holding immense bodies of water, each playing most important parts in making the several shoals, the subject is somewhat complex.

Sandy Hook Bay, with its Navesink and Shrewsbury Rivers back of it, is the second large force, whilst the Raritan Bay, with its back water areas, Raritan River and Arthur Kill, is the third. On the ebb tide the harbor waters run almost due south into the outer bay ; at the same time of the tide the Sandy Hook Bay waters run about due north, in an entirely opposite direction, while the Raritan Bay waters run due east, elbowing their way out into the ocean through the forces already described. An exact knowledge of the areas over which these forces operate is, therefore, essential to rightly determine where harbor improvements can best be made. Nature is the best guide, and a study of the several shoals between Sandy Hook and Coney Island will show, in a surprising degree, the area and limitation of those forces. A section of the harbor's entrance on a line due north from Sandy Hook to the west end of Coney Island makes the Dry Romer Shoal the approximate dividing line of the northernmost or harbor force on the one side, with the south and east forces from Sandy Hook Bay and Raritan River on the other side, this being corroborated by a careful estimate of the tidal capacities of the several basin or tidal reservoirs. If this is so, it is evident that the East or northernmost channel is acted upon by one set only of tidal waters in no way antagonistic in their movements to any line of travel that might be proposed over that route, and consequently best able to maintain that route clear by a natural scour, while the two other channels, namely, the Swash and the Ship, have their paths beset by not less than three distinct sets of waters, which, at their several meeting points, cause conflicting currents, large and constant deposits and changes of channel beds.

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The absolutely safe and more scientific way would be to test and ascertain beyond peradventure the exact movements of the currents in all the channels at all times of the tides ; a somewhat laborious but in no way expensive or impossible task, especially when we

consider the magnitude of the interests involved. From experience that has been gained in this and in other countries, it is well to make haste slowly in making harbor improvements, and not to embark on any set of works likely to alter the regimen of the harbor's water until its possibilities have been canvassed from every standpoint. A wrong once done, such as might arise in an entire redistribution of the forces, can only be remedied at an enormous outlay, both as regards time and money. As before stated, a very moderate outlay and six months' time would furnish a knowledge of all the forces that would have to be encountered. With this in our possession, it would be perfectly easy to compute how far nature might be utilized, and it is certain that unless nature assists very fully, great additional, and often useless, expense must be incurred. Such an examination of the currents at all depths and at all times of tide would doubtless demonstrate just how far each channel was operated upon by the three forces named, and the result of such knowledge would probably show that the proper treatment should be purely local, only applied to one of the existing channels, utilizing the forces of nature in its vicinity. Any other project attempting a large disturbance, such as might be created by the blocking of a considerable section of the harbor's entrance, would, by destroying the existing shoals, make other channels that would probably be beset with greater difficulties than those now in use.

Doubtless there are many plans and ideas for giving New-York what she requires—a *deep water channel.* These, one and all, should be submitted to a competent Board before any sum of money is granted for a particular work.